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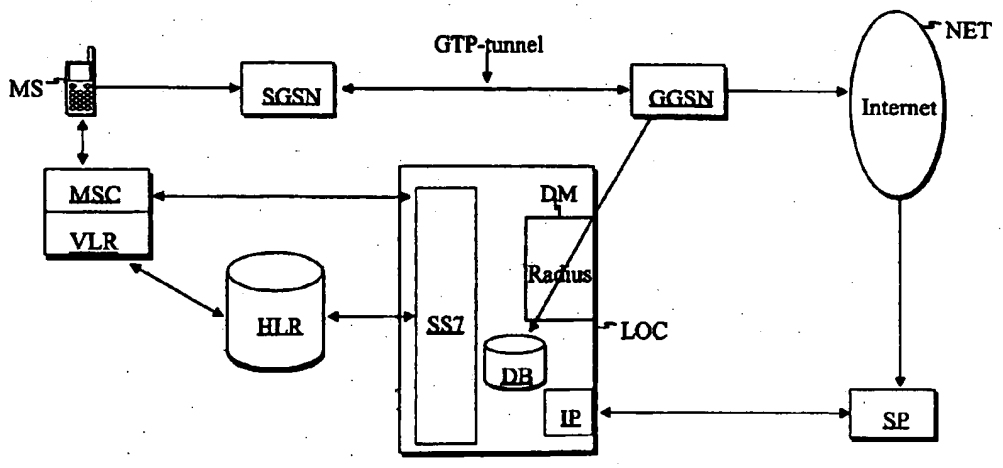

(57) Abstract: The invention relates to a method and system for obtaining the location information of a terminal device of a telecommunication network, in which method a context associated with the opening of a data-transmission connection is created and location-dependant service request is sent to the service provider by means of the terminal device. According to the invention, the IP address allocated to the context and the subscriber identifier of the user of the terminal device are found out; the IP address allocated to the context and the subscriber identifier of the user of the terminal device are saved to the database; an inquiry is sent from the service provider that contains the IP address allocated to the context; based on the inquiry, the subscriber identifier associated with the IP address is checked from the database; the piece of location information of the subscriber is found out based on the subscriber identifier utilizing the location server; and the piece of location information is sent from the location server to the service provider.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Positioning of terminal equipment

FIELD OF THE INVENTION

The present invention relates to telecommunication technique. The present invention relates to a method and system for obtaining the location information of a terminal device of a packet-switched telecommunication network.

BACKGROUND OF THE INVENTION

Location-dependant notifications and services may be offered to a wireless terminal device, if only the location of the terminal device is known with a sufficient accuracy. In a mobile communication network, it is possible to try to determine the location of the terminal device e.g. by measuring the signals of the base stations.

At present, one specific problem is that the terminal device of a GPRS network (GPRS, Global Packet Radio Service) cannot be located with the accuracy of a cell. The basic factor for this problem is that on the IP interface of the GPRS network, no specific subscriber identifier is used. In the GSM system, visible is only the IP address (IP, Internet Protocol) of the entity that requested the service. The IP address is, in addition, often dynamic by nature, i.e. it is created for each connection specifically.

One solution to the problem is to integrate a GPS positioning system (GPS, Global Positioning System) into the terminal device of a mobile communication network. This kind of solution is, however, costly. In addition, terminal devices become complicated.

OBJECTIVE OF THE INVENTION

The objective of the invention is to eliminate the drawbacks referred to above or at least significantly to alleviate them. One specific objective of the invention is to disclose a new type of method and system which enable one to locate a terminal device of a packet-switched telecommunication network such as a GPRS network with the accuracy of a cell.

BRIEF DESCRIPTION OF THE INVENTION

The present invention relates to the obtaining of the location information of a GPRS terminal device. In the invention, a subscriber identifier/IP address pairs are got from the GPRS network and they are saved to the database. These pairs are being utilized when locating a GPRS terminal device.

The invention relates to a method for obtaining the location information of a terminal device of a packet-switched telecommunication network, in which method, a context associated with the opening of a data-transmission connection is created, and a location-dependant service request is sent to the service provider by means of the terminal device. The context may be created by the terminal device or the telecommunication network. When the context is created, the terminal device is allocated an IP address, which is ordinarily dynamic.

According to the invention, the IP address allocated to the context and the subscriber identifier of the user of the terminal device are found out, and the subscriber identifier/IP address pair is saved to the database. The service provider sends an inquiry which contains the IP address allocated to the context. The subscriber identifier corresponding to the IP address is retrieved from the database, the identifier being advantageously a MSISDN number (MSISDN, Mobile Subscriber ISDN) or IMSI (IMSI, International Mobile Subscriber Identity). A location server is used

to find out the location information of the subscriber based on the subscriber identifier. When the location information has been found out, it is sent to the service provider. The location information is advantageously used to mean CellID information.

When the context is released, the subscriber identifier associated with the context and the IP address are deleted from the database.

The invention also relates to a method for obtaining the location information of a terminal device of a GPRS network. In the method, a PDP context (PDP, Packet Data Protocol) associated with the data-transmission connection is opened, and a location-dependant service request is sent to the service provider by means of the terminal device. The PDP context may be created by the terminal device or the telecommunication network.

According to the invention, the IP address allocated to the PDP context and the subscriber identifier of the user of the GPRS terminal device are found out, and they are saved to the database. The service provider sends an inquiry which contains the IP address allocated to the PDP context. Based on this, it is possible to retrieve from the database the subscriber identifier of the user of the GPRS terminal device that is preferably a MSISDN number. Based on the subscriber identifier, the location server finds out the IMSI identifier from the home location register, and further the address of the SGSN node (SGSN, Serving GPRS Support Node) serving the GPRS terminal device.

The location server sends a BSSAP+ MS Information Request message (BSSAP, Base Station System Application Part) to the SGSN node. The SGSN node sends the location information of the GPRS terminal device to the location server in a BSSAP+ MS Information Response message. The location server transmits the lo-

cation information further to the service provider. The location information is advantageously used to mean CellID information. When the PDP context is released, the subscriber identifier associated with the PDP context and the IP address are deleted from the database.

The IP address allocated to the PDP context and the subscriber identifier of the user of the GPRS terminal device may be found out in many different ways. The GGSN node may send e.g. by means of the Radius protocol a radius message to the Radius server program, the radius message containing the IP address allocated to the PDP context and the subscriber identifier of the user of the GPRS terminal device. The location server may be used to monitor the GTP tunnel (GTP, Gateway Tunnel Protocol) between the SGSN node and the GGSN node and to pick up subscriber identifier/IP address pairs from there in the creation phase of the PDP context. The SGSN node may send subscriber identifier/IP address pairs to the location server.

The invention also relates to a method for obtaining the location information of a terminal device of a GPRS network. In the method, a PDP context associated with the opening of a data-transmission connection is created, and a location-dependant service request is sent to the service provider by means of the terminal device. The PDP context may be created by the terminal device or the telecommunication network.

According to the invention, the IP address allocated to the PDP context and the subscriber identifier of the user of the terminal device are found out, and they are saved to the database. The service provider sends an inquiry which contains the IP address allocated to the PDP context. Based on this, from the database, the subscriber identifier of the user of the GPRS terminal device is retrieved that is

advantageously a MSISDN number. The location server sends an ATI message (ATI, Any Time Interrogation) consistent with the MAP protocol to the home location register, the ATI message containing the subscriber identifier of the user of the GPRS terminal device. Instead of an ATI message, a SRI message (SRI, Send Routing Info) consistent with the MAP protocol may be used. The home location register converts the ATI inquiry into a PSI inquiry (PSI, Provide Subscriber Info) consistent with the MAP protocol and sends the PSI inquiry to the visitor location register. The visitor location register directs the PSI inquiry to the SGSN node using the MS Information Request message of the BSSAP+ protocol. The SGSN node returns the location information of the GPRS terminal device to the visitor location register in a MS Information Response message. The visitor location register sends a PSI response message to the visitor location register that contains the location information. The visitor location register in turn sends an ATI response message to the location server that contains the location information. The location server transmits the location information further to the service provider. The location information is advantageously used to mean CellID information. When the PDP context is released, the subscriber identifier associated with the PDP context and the IP address are deleted from the database.

The IP address allocated to the PDP context and the subscriber identifier of the user of the GPRS terminal device may be found out in many different ways. The GGSN node may send e.g. by means of the Radius protocol a radius message to the Radius server program, the radius message containing the IP address allocated to the PDP context and the subscriber identifier of the user of the GPRS terminal device. The location server may be used to monitor the GTP tunnel between the SGSN node and the GGSN node and to pick up

subscriber identifier/IP address pairs from there in the creation phase of the PDP context. The SGSN node may send subscriber identifier/IP address pairs to the location server.

The invention also relates to a method for obtaining the location information of a terminal device of a GPRS network. In the method, a PDP context associated with the opening of a data-transmission connection is created, and a location-dependant service request is sent to the service provider by means of the terminal device. The PDP context may be created by the terminal device or the telecommunication network.

According to the invention, the IP address allocated to the PDP context and the subscriber identifier of the user of the terminal device are found out, and they are saved to the database. The service provider sends an inquiry which contains the IP address allocated to the PDP context. Based on this, from the database, the subscriber identifier of the user of the GPRS terminal device is retrieved that is advantageously a MSISDN number. The location server is used to find out the IMSI identifier and the address of the serving mobile switching center from the home location register based on the subscriber identifier. The location server sends a short message to the GPRS terminal device using a circuit-switched connection.

After this, the location server sends an ATI message consistent with the MAP protocol to the home location register, the ATI message containing the subscriber identifier of the user of the GPRS terminal device. Instead of an ATI message, a SRI message consistent with the MAP protocol may be used. The home location register converts the ATI inquiry into a PSI inquiry consistent with the MAP protocol and sends it to the visitor location register. The visitor location register sends to the home location register a PSI re-

sponse message that contains the location information. The home location register in turn sends to the location server an ATI response message that contains the location information. The location server sends a MAP Abort message to the mobile switching center, if a MMS bit (MMS, More Messages to Send) was activated in the short message sent to the GPRS terminal device from the location server utilizing the circuit-switched connection. The location server transmits the location information further to the service provider. The location information is advantageously used to mean CellID information. When the PDP context is released, the subscriber identifier associated with the PDP context and the IP address are deleted from the database.

The IP address allocated to the PDP context and the subscriber identifier of the user of the GPRS terminal device may be found out in many different ways. The GGSN node may send e.g. by means of the Radius protocol a radius message to the Radius server program, the radius message containing the IP address allocated to the PDP context and the subscriber identifier of the user of the GPRS terminal device. The location server may be used to monitor the GTP tunnel between the SGSN node and the GGSN node and to pick up subscriber identifier/IP address pairs from there in the creation phase of the PDP context. The SGSN node may send subscriber identifier/IP address pairs to the location server.

The invention relates to a location server for obtaining the location information of a terminal device of a packet-switched telecommunication network. According to the invention, the location server comprises message means for sending and receiving messages to the service provider/from the service provider, and a signaling interface for sending and receiving signaling messages.

In one embodiment of the invention, the location server comprises a database for saving the subscriber identifier/IP address pairs.

In one embodiment of the invention, the location server comprises data acquisition means for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device. The data acquisition means are also used to transmit the subscriber identifier/IP address pair to the database. The data acquisition means are used to refer e.g. to the Radius server program.

In one embodiment of the invention, the location server comprises message means for retrieving the subscriber identifier/IP address pairs from the database.

In one embodiment of the invention, the data acquisition means are used to refer to a data collector which is used to monitor the GTP tunnel between the SGSN node and the GGSN node.

In one embodiment of the invention, the signaling interface comprises means for sending and receiving signaling messages to the home location register/from the home location register and to the SGSN node/from the SGSN node.

In one embodiment of the invention, the signaling interface comprises means for sending and receiving signaling messages to the home location register/from the home location register.

In one embodiment of the invention, the signaling interface comprises means for sending and receiving signaling messages to the home location register/from the home location register and to the mobile switching center/from the mobile switching center.

In one embodiment of the invention, the signaling interface comprises means for sending and receiving signaling messages to the home location regis-

ter/from the home location register and to the visitor location register/from the visitor location register.

The invention also relates to a system for obtaining the location information of a terminal device of a GPRS network. The system comprises SGSN node, a GGSN node, which is connected to the SGSN node, a GTP tunnel, which is located in between the SGSN node and the GGSN node, a service provider, which communicates with the GGSN node, a GPRS terminal device, which communicates with the SGSN node, and a home location register.

According to the invention, the system comprises data acquisition means for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device and for saving the subscriber identifier/IP address pairs obtained using the data acquisition means of the database. The system further comprises a location server which comprises message means for sending and receiving messages to the service provider/from the service provider, and a signaling interface for sending and receiving signaling messages to the home location register/from the home location register and to the SGSN node/from the SGSN node.

In one embodiment of the invention, the location server comprises a database for saving the subscriber identifier/IP address pairs.

In one embodiment of the invention, the location server comprises message means for retrieving the subscriber identifier/IP address pairs from the database.

In one embodiment of the invention, the location server comprises data acquisition means for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device.

In one embodiment of the invention, the data acquisition means are used to refer to a Radius server

program which receives information from the Radius client program of the GGSN node.

In one embodiment of the invention, the data acquisition means are used to refer to a data collector which is used to monitor the GTP tunnel in between the SGSN node and the GGSN node.

In one embodiment of the invention, the SGSN node comprises data transmission means for sending the subscriber identifier/IP address pair to the location server.

The invention relates to a system for obtaining the location information of a terminal device of a GPRS network. The system comprises a SGSN node, a GGSN node, which is connected to the SGSN node, a GTP tunnel, which is located in between the SGSN node and the GGSN node, a service provider, which communicates with the GGSN node, a GPRS terminal device, which communicates with the SGSN node, a home location register, a visitor location register, which communicates with the home location register, and a mobile switching center which communicates with the visitor location register.

According to the invention, the system comprises data acquisition means for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device, and a database for saving the subscriber identifier/IP address pairs obtained using the data acquisition means. The system further comprises a location server which comprises message means for sending and receiving messages to the service provider/from the service provider, and a signaling interface for sending and receiving signaling messages to the home location register/from the home location register.

In one embodiment of the invention, the location server comprises a database for saving the subscriber identifier/IP address pairs.

In one embodiment of the invention, the location server comprises message means for retrieving the subscriber identifier/IP address pairs from the database.

In one embodiment of the invention, the location server comprises data acquisition means for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device.

In one embodiment of the invention, the data acquisition means are used to refer to a Radius server program which receives information from the Radius client program of the GGSN node.

In one embodiment of the invention, the data acquisition means are used to refer to a data collector which is used to monitor the GTP tunnel in between the SGSN node and the GGSN node.

In one embodiment of the invention, the SGSN node comprises data transmission means for sending the subscriber identifier/IP address pair to the location server.

In one embodiment of the invention, the signaling interface comprises means for sending and receiving signaling messages to the visitor location register/from the visitor location register.

The invention also relates to a system for obtaining the location information of a terminal device of a GPRS network. The system comprises a SGSN node, a GGSN node, which is connected to the SGSN node, a GTP tunnel, which is located in between the SGSN node and the GGSN node, a service provider, which communicates with the GGSN node, a GPRS terminal device, which communicates with the SGSN node, a home location register, a visitor location register, which communicates with the home location register and the SGSN node, and a mobile switching center which communicates with the visitor location register.

According to the invention, the system comprises data acquisition means for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device, and a database for saving the subscriber identifier/IP address pairs obtained using the data acquisition means. The system further comprises a location server which comprises message means for sending and receiving messages to the service provider/from the service provider, and a signaling interface for sending and receiving signaling messages to the home location register/from the home location register and to the mobile switching center/from the mobile switching center.

In one embodiment of the invention, the location server comprises a database for saving the subscriber identifier/IP address pairs.

In one embodiment of the invention, the location server comprises message means for retrieving the subscriber identifier/IP address pairs from the database.

In one embodiment of the invention, the location server comprises data acquisition means for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device.

In one embodiment of the invention, the data acquisition means are used to refer to a Radius server program which receives information from the Radius client program of the GGSN node.

In one embodiment of the invention, the data acquisition means are used to refer to a data collector which is used to monitor the GTP tunnel in between the SGSN node and the GGSN node.

In one embodiment of the invention, the SGSN node comprises data transmission means for sending the subscriber identifier/IP address pair to the location server.

In one embodiment of the invention, the signaling interface comprises means for sending and receiving signaling messages to the visitor location register/from the visitor location register.

Thanks to the present invention, a GPRS terminal device equipped with the short message facility of a circuit-switched mobile communication network, as well as a terminal device equipped merely with the GPRS facility may be located with the accuracy of a cell.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following section, the invention will be described in detail with the aid of the examples of its embodiments, in which

Fig. 1 represents one advantageous system in accordance with the invention,

Fig. 2 represents one advantageous system in accordance with the invention,

Fig. 3 represents one advantageous system in accordance with the invention,

Fig. 4 represents one advantageous system in accordance with the invention,

Fig. 5 represents one advantageous system in accordance with the invention,

Fig. 6 is one advantageous signaling flow chart illustrating the function of the method in accordance with the invention,

Fig. 7 is one advantageous signaling flow chart illustrating the function of the method in accordance with the invention, and

Fig. 8 is one advantageous flow chart illustrating the function of the method in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

The system as shown in Fig. 1 comprises a GPRS terminal device MS, which communicates with the SGSN node SGSN. The SGSN node is connected to the GGSN node via the GTP tunnel. The SGSN, GGSN and GTP are the basic concepts of the GPRS system, further information on which is available e.g. in the standard ETSI EN 301 344 V6.6.0 (2000-02)of ETSI (ETSI, European Telecommunication Standardization Organization). From the GGSN node there is a connection to the service provider SP via the Internet NET. The system as shown in Fig. 1 comprises, in addition, a mobile switching center MSC (MSC, Mobile Switching Center) and a visitor location register VLR (VLR, Visitor Location Register), from which there is a connection to the home location register HLR (HLR, Home Location Register). From the home location register HLR there is a connection to the location server LOC.

According to the invention, the system comprises also a location server LOC from which there is a connection to the service provider SP, home location register HLR and to the GGSN node. The location server LOC comprises data acquisition means DM for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device, a database DB for saving the subscriber identifier/IP address pair obtained using the data acquisition means DM, message means IP for sending and receiving messages to the service provider/from the service provider SP, and a signaling interface SS7 for sending and receiving messages to the home location register/from the home location register HLR and to the mobile switching center/from the mobile switching center MSC.

The data acquisition means DM are advantageously used to refer to a Radius server program. In the GGSN node there is implemented a Radius protocol. More information on the Radius protocol is available

e.g. in the publications RFC 2058 and RFC 2059 (RFC, Request For Comments). When a PDP context is opened from the terminal device MS, the Radius client program of the GGSN node sends a Radius message to the Radius server program DM of the location server LOC. The PDP context may be created by the terminal device or the telecommunication network. The message contains the dynamic IP address allocated to the PDP context and the subscriber identifier associated with the user of the terminal device, advantageously a MSISDN number. From the Radius server program DM, the dynamic IP address and the MSISDN number are copied to the database DB. When the PDP context is released, the connection between the subscriber identifier and the IP address is deleted. The Radius client program in the GGSN node sends a released message which contains the subscriber identifier and the dynamic IP address. As a consequence of this, the subscriber identifier/IP address pair is deleted from the database DB.

In one embodiment of Fig. 1, the Radius server program DB and/or the database DB are separate components of the location server LOC.

Fig. 2 represents one system in accordance with the invention that differs only little from the system as shown by Fig. 1. In the system as shown by Fig. 2, no Radius protocol is needed. Instead, in the GTP tunnel in between the SGSN node and the GGSN node, a monitoring unit DM is installed that monitors the traffic between the two aforementioned nodes. The monitoring unit DM retrieves the subscriber identifier/IP address pairs created in the creation phase of the PDP context. When this kind of pair is found, it is saved to the database DB. When the PDP context is released, the connection between the subscriber identifier and the IP address is deleted. This piece of information is monitored from the GTP tunnel, and as a

consequence of this, the subscriber identifier/IP address pair is deleted from the database DB.

In one embodiment of Fig. 2, the monitoring unit DB and/or the database DB are separate components of the location server LOC.

Fig. 3 represents one system in accordance with the invention that differs only little from the system as shown by Fig. 1. In the system as shown by Fig. 3, a monitoring unit resembling the one shown in Fig. 2 is constructed in the SGSN node. The SGSN node sends a notification of all the subscriber identifier/IP address pairs to the location server LOC. When the PDP context is released, the SGSN node sends a notification thereof to the location server LOC. The functioning described above may be implemented e.g. by means of the Radius protocol in such a way that the SGSN node comprises a Radius client program MM and the location server LOC a Radius server program DM.

In one embodiment of Fig. 3, the Radius server program DB and/or the database DB are separate components of the location server LOC.

The system as shown in Fig. 4 comprises a GPRS terminal device MS which communicates with the SGSN node SGSN. The SGSN node is connected to the GGSN node by means of the GTP tunnel. There is a connection from the GGSN node to the service provider SP via the Internet NET. The system as shown in Fig. 4 comprises, in addition, a home location register HLR. In the system as shown in Fig. 4 it has been presented that the obtaining of the subscriber identifier/IP address pair information associated with the PDP context has been implemented by means of the Radius protocol and the GGSN node, just like in Fig. 1. The subscriber identifier/IP address pair information may alternatively be obtained in a manner as shown by Fig. 2 (monitoring unit) or as shown by Fig. 3 (SGSN). The location server LOC as shown in Fig. 4 differs from the loca-

tion server shown in Fig. 1 in that the signaling interface SS7 may be used to send and receive messages to the home location register/from the home location register HLR and to the SGSN node/from the SGSN node.

In one embodiment of Fig. 4, the Radius server program DB and/or the database DB are separate components of the location server LOC.

The system as shown in Fig. 5 comprises a GPRS terminal device MS which communicates with the SGSN node SGSN. The SGSN node is connected to the GGSN node by means of the GTP tunnel. There is a connection from the GGSN node to the service provider SP via the Internet NET. The system as shown in Fig. 5 comprises, in addition, a mobile switching center MSC and a visitor location register VLR, from which there is a connection to the home location register HLR and to SGSN node. There is a connection from the home location register HLR to the location server LOC. In the system as shown in Fig. 5 it has been presented that the obtaining of the subscriber identifier/IP address pair information associated with the PDP context has been implemented by means of the Radius protocol and the GGSN node, just like in Fig. 1. The subscriber identifier/IP address pair information may alternatively be obtained in a manner as shown by Fig. 2 (monitoring unit) or as shown by Fig. 3 (SGSN). The signaling interface SS7 may be used to send and receive messages to the home location register/from the home location register HLR.

In one embodiment of Fig. 5, the Radius server program DB and/or the database DB are separate components of the location server LOC.

Fig. 6 is a signaling flow chart illustrating the function of the method of the invention in the system as shown in Fig. 1. Differing from the system as shown by Fig. 1, the Radius server DM and the database DB have in the example of Fig. 6 been separated

as separate components apart from the location server LOC. They can, however, be also a part of the location server LOC.

The GPRS terminal device MS opens a PDP context to the SGSN node and from it further to the GGSN node, arrows 1- 3. The Radius client program of the GGSN node sends a Radius message (Accounting Start) to the Radius server program DM, arrow 4. The message contains at least a subscriber identifier (MSISDN) and a dynamic IP address. From the Radius server program DM, the subscriber identifier and the dynamic IP address are copied to the database DB, arrow 5. When the service provider receives a location-dependant service request, arrow 6, it makes, based on the dynamic IP address of the sender that is contained in the service request, a subscriber identifier inquiry to the database DB, arrow 7. The location-dependant service request is used to mean e.g. a request received from the GPRS terminal device MS in which one wishes to know the restaurants in the neighbourhood. The database DB returns to the service provider SP the subscriber identifier associated with the IP address that is advantageously a MSISDN number, arrow 8. The service provider SP sends to the message means IP of the location server LOC a location information request which contains the subscriber identifier (MSISDN), arrow 9. The message means IP transmit the subscriber identifier further to the signaling interface SS7, arrow 10.

The signaling interface SS7 sends to the home location register HLR a Send Routing Info for Short Message inquiry which contains the subscriber identifier MSISDN, arrow 11. As shown by arrow 12, the home location register HLR responds with a Send Routing Info for Short Message Response message. This message contains the IMSI identifier corresponding to the MSISDN number. In addition, it contains the address of the mobile switching center MSC serving the circuit-

switched mobile station part of the GPRS terminal device MS, e.g. the GSM part (GSM, Global System for Mobile communications). The signaling interface SS7 sends a short message to the GPRS terminal device MS by means of a circuit-switched connection via the mobile switching center MSC and the base station controller BSC using a Forward Short Message, arrow 13. The FSM message contains a MMS parameter (More Messages To Send). If the MMS parameter has been activated in the message, the GPRS terminal device MS keeps waiting for new short messages for a while, and because of this, the visitor location register VLR stores the cell information as long as the radio connection is open. If the MMS parameter is not activated, the visitor location register VLR contains the cell information (CellID) only for a while, and after this, there is only the LAI information remaining (LAI, Location Area Identity). The GPRS terminal device MS sends a FMS Ack message to the signaling interface SS7, arrow 14. The FSM message has been described in more detail e.g. in the standard of ETSI ETSI TS 100 974 V7.5.1 (2000-09).

The signaling interface SS7 sends an ATI inquiry consistent with the MAP protocol to the home location register HLR, arrow 15. An operation alternative to the ATI inquiry is a Send Routing Info (SRI). The home location register HLR converts this inquiry into a PSI operation and sends a new inquiry to the visitor location register VLR, arrow 16. The visitor location register VLR returns the location information (CellID) to the home location register HLR in a PSI Ack message, arrow 17. As shown by arrow 18, the home location register HLR sends to the signaling interface SS7 an ATI Response message which contains the piece of location information. The signaling interface SS7 sends, in addition, a MAP Abort message to the mobile switching center MSC, arrow 19. The meaning of this

message is that the circuit-switched radio connection earlier established to the terminal device GPRS is released. The MAP Abort message is sent, however, only when the MMS bit was activated in the FSM message as shown by arrow 13. In other words, if the visitor location register VLR supports the storing of the latest cell information, then an ordinary short message is sent that does not contain the activated MMS bit. If the visitor location register VLR does not support this feature, then a short message is sent that contains the activated MMS bit. In that case, one has to use a MAP Abort message, as shown above.

The peace of location information is transmitted to the service provider as shown by arrows 20 and 21. When the PDP context previously established is released, the Radius client program of the GGSN node transmits a released message (Accounting Stop) to the Radius server program DM, arrow 22. The released message contains the subscriber identifier and the dynamic IP address. As a consequence of this, the subscriber identifier/IP address pair is deleted from the database, arrow 23.

In the signal flow chart as shown by Fig. 6 it has been presented that the obtaining of the piece of information on the subscriber identifier/IP address pair associated with the PDP context has been implemented by means of the Radius protocol and the GGSN node. Alternatively, the subscriber identifier/IP address pair may be obtained e.g. in a manner as shown by Fig. 2 (monitoring unit) or as shown by Fig. 3 (SGSN).

Fig. 7 is a signaling flow chart illustrating the function of the method of the invention in the system as shown in Fig. 4. Differing from the system as shown by Fig. 4, the Radius server DM and the database DB have in the example of Fig. 7 been separated as separate components apart from the location server

LOC. They can, however, be also a part of the location server LOC.

The GPRS terminal device MS opens a PDP context to the SGSN node and from it further to the GGSN node, arrows 24 - 26. The Radius client program of the GGSN node sends a Radius message (Accounting Start) to the Radius server program DM, arrow 27. The message contains at least a subscriber identifier (MSISDN) and a dynamic IP address. From the Radius server program DM, the subscriber identifier and the dynamic IP address are copied to the database DB, arrow 28. When the service provider SP receives a location-dependant service request, it makes, based on the dynamic IP address of the sender that is contained in the service request, a location information inquiry to the location server LOC, arrows 29 and 30. The location-dependant service request is used to mean e.g. a request received from the GPRS terminal device MS in which one wishes to know the restaurants in the neighbourhood. The message means IP of the location server LOC are used check from the database DB with what subscriber identifier the received dynamic IP address is associated, arrows 31 and 32. The subscriber identifier is transmitted further to the signaling interface SS7.

The signaling interface SS7 sends to the home location register HLR a Send IMSI inquiry which contains the subscriber identifier MSISDN, arrow 34. As shown by arrow 35, the home location register HLR sends an IMSI identifier to the signaling interface SS7. Next, the signaling interface SS7 sends to the home location register HLR a Send routing Info for GPRS service inquiry which contains the IMSI identifier previously retrieved, arrow 36. As shown by arrow 37, the signaling interface SS7 receives as a response the address of the SGSN node in whose area the GPRS terminal device MS is located. After this, the signal-

ing interface SS7 sends, as shown by arrow 38, a MS information request message consistent with the BSSAP+ protocol to the SGSN node. The SGSN node returns the MS CellID information of the GPRS terminal device to the signaling interface SS7 in the MS Information Response message of the BSSAP+ protocol, arrow 39. The BBSSAP+ protocol has been described in more detail e.g. in the standard of ETSI STSI TS 101 346 V6.5.0 (1999-11).

The piece of location information is transmitted to the service provider SP, as shown by arrows 40 and 41. When the PDP context previously established is released, the Radius client program of the GGSN node transmits a released message (Accounting Stop) to the Radius server program DM, arrow 42a. The released message contains the subscriber identifier and the dynamic IP address. As a consequence of this, the subscriber identifier/IP address pair is deleted from the database DB, arrow 42b.

In the signal flow chart as shown by Fig. 7 it has been presented that the obtaining of the piece of information on the subscriber identifier/IP address pair associated with the PDP context has been implemented by means of the Radius protocol and the GGSN node. Alternatively, the subscriber identifier/IP address pair may be obtained e.g. in a manner as shown by Fig. 2 (monitoring unit) or as shown by Fig. 3 (SGSN).

Fig. 8 is a signaling flow chart illustrating the function of the method of the invention in the system as shown in Fig. 5. The database DB and the Radius server DM are in this example internal features of the location server LOC.

The GPRS terminal device MS opens a PDP context to the SGSN node and from it further to the GGSN node, arrows 43 - 45. The Radius client program of the GGSN node sends a Radius message (Accounting Start) to

the Radius server program DM, arrow 46. The message contains at least a subscriber identifier (MSISDN) and a dynamic IP address. From the Radius server program DM, the subscriber identifier and the dynamic IP address are copied to the database DB, arrow 47. When the service provider SP receives a location-dependant service request, it makes, based on the dynamic IP address of the sender that is contained in the service request, a location information inquiry to message means IP of the location server LOC, arrows 48 and 49. The location-dependant service request is used to mean e.g. a request received from the GPRS terminal device MS in which one wishes to know the restaurants in the neighbourhood. The message means IP of the location server LOC are used check from the database DB with what subscriber identifier the received dynamic IP address is associated, arrows 50 and 51. The subscriber identifier is transmitted further to the signaling interface SS7, arrow 52.

The signaling interface SS7 sends to the home location register HLR an ATI inquiry consistent with the MAP protocol, arrow 53. An alternative operation to the ATI inquiry is a Send routing Info (SRI). The home location register HLR converts this inquiry into a PSI operation and sends a new inquiry to the visitor location register VLR, arrow 54. The visitor location register VLR forwards this inquiry to the SGSN node using the Gs interface of the GPRS system, the BSSAP+ Protocol and the MS Information Request message, arrow 55. As a consequence of the inquiry, the SGSN node returns the CellID information to the visitor location register VLR in a MS Information Response Message, arrow 56. The visitor location register VLR returns the CellID information to the home location register HLR in a PSI Ack message, arrow 57. As shown by arrow 58, the home location register HLR sends to the signaling

interface SS7 an ATI Response message which contains the piece of location information.

The piece of location information is transmitted to the service provider SP, as shown by arrows 59 and 60. When the PDP context previously established is released, the Radius client program of the GGSN node transmits a released message (Accounting Stop) to the Radius server program DM of the location server LOC, arrow 61. The released message contains the subscriber identifier and the dynamic IP address. As a consequence of this, the subscriber identifier/IP address pair is deleted from the database DB, arrow 62.

In the signal flow chart as shown by Fig. 8 it has been presented that the obtaining of the piece of information on the subscriber identifier/IP address pair associated with the PDP context has been implemented by means of the Radius protocol and the GGSN node. Alternatively, the subscriber identifier/IP address pair may be obtained e.g. in a manner as shown by Fig. 2 (monitoring unit) or as shown by Fig. 3 (SGSN).

Thanks to the invention it is possible to locate a GPRS terminal device with the accuracy of a cell area. The systems/methods as shown in Figs. 1, 2, 3 and 6 require that the GPRS terminal device is equipped with the short message feature of a circuit-switched mobile communication network, e.g. a GSM network. Figs. 4, 5, 7 and 8 present a system/method which functions also in such a case when the GPRS terminal device is equipped solely with the GPRS feature. Although it has been presented in the examples of Figs. 1 and 3 - 8 that the data acquisition means DM refer to a Radius server program and that the subscriber identifier/IP address pair is received from the GGSN node or the SGSN node by means of the Radius client program, the data acquisition means DM may re-

fer to any other means by means of which the subscriber identifier/IP address pair may be found out.

In Fig. 6 it has been presented that the service provider SP asks for the subscriber identifier (MSISDN) from the database DB by means of the IP address. In Fig. 7 it has been presented that the same inquiry is made by the location server LOC. In Figs. 6 and 7, the database DB and the Radius server DM are separate components of the location server LOC. In the example of Fig. 8, the database DB and the Radius server DM are internal features of the location server LOC. These are, however, implementations of the method and system of the invention by way of example only.

In the examples as shown by Figs. 1 - 3, 5, 6 and 8, the home location register HLR makes a PSI inquiry to the visitor location register after the ATI inquiry. The location server LOC may make a PSI inquiry directly to the visitor location register VLR when necessary in such a way that it is not necessary to send an ATI inquiry at all. This requires, however, that the signaling interface SS7 of the location server LOC checks from the home location register the IMSI identifier corresponding to the MSISDN number and the address of the visitor location register VLR. This information the signaling interface SS7 gets from the home location register e.g. by means of a Send Routing Info message or by means of a Send Routing Info for Short Message. The Send Routing Info inquiry is used to find out the address of the mobile switching center MSC from which one can derive the address of the visitor location register VLR. The Send Routing Info for Short Message inquiry is used to find out the address of the visitor location register VLR. The visitor location register VLR returns the piece of location information (CELLID) of the GPRS terminal device MS to the signaling interface SS7 in a PSI Response message.

The invention is not restricted merely to the examples of its embodiments referred to above, instead many variations are possible within the scope of the inventive idea defined by the claims.

CLAIMS

1. A method for obtaining the location information of a terminal device of a packet-switched telecommunication network, in which method

a context associated with the opening of a data-transmission connection is opened;

a location-dependant service request is sent to the service provider using the terminal device;

characterized in that the method comprises the steps of:

a) finding out the IP address allocated to the context and the subscriber identifier of the user of the terminal device;

b) saving the IP address allocated to the context and the subscriber identifier of the user of the terminal device to the database;

c) sending an inquiry from the service provider that contains the IP address allocated to the context;

d) checking the subscriber identifier associated with the IP address from the database based on the inquiry;

e) checking the location information of the subscriber from the database based on the subscriber identifier using the location server; and

f) sending the piece of location information from the location server to the service provider.

2. The method according to claim 1, characterized in that the subscriber identifier is IMSI.

3. The method according to claim 1, characterized in that the subscriber identifier is a MSISDN number.

4. The method according to claim 1, characterized in that the subscriber identifier associated with the context and the IP address are deleted from the database, when the context is released.

5. The method according to claim 1, c h a r a c t e r i z e d in that the piece of location information is a CellID identifier.

6. A method for obtaining the location information of a terminal device of a GPRS network, which method comprises the steps of:

creating a PDP context associated with the opening of a data-transmission connection;

sending a location-dependant service request to the service provider using the terminal device;

c h a r a c t e r i z e d in that the method further comprises the steps of:

a) finding out the IP address allocated to the PDP context and the subscriber identifier of the user of the terminal device.

b) saving the IP address allocated to the PDP context and the subscriber identifier of the user of the terminal device to the database;

c) sending an inquiry to the service provider that contains the IP address allocated to the PDP context;

d) finding out the subscriber identifier associated with the IP address from the database based on the inquiry;

e) finding out the IMSI identifier from the home location register based on the subscriber identifier using the location server;

f) finding out the SGSN node serving the GPRS terminal device from the home location register using the location server;

g) sending a BSSAP+ MS Information Request message from the location server to the SGSN node;

h) sending the piece of location information of the GPRS terminal device from the SGSN node to the location server in a BSSAP+ MS Information Response message; and

i) transmitting the received piece of location information from the location server to the service provider.

7. The method according to claim 6, characterized in that at step a) sending from the GGSN node, by means of the Radius protocol, a radius message to the Radius server program that contains the IP address allocated to the PDP context and the subscriber identifier of the user of the terminal device.

8. The method according to claim 6, characterized in that at step a) monitoring the GTP tunnel in between the SGSN node and the GGSN node by means of the location server and picking up subscriber identifier/IP address pairs from there in the creation phase of the PDP context.

9. The method according to claim 6, characterized in that at step a) sending the subscriber identifier/IP address pair from the SGSN node to the location server.

10. The method according to claim 6, characterized in that the subscriber identifier associated with the PDP context and the IP address are deleted from the database, when the PDP context is released.

11. The method according to claim 6, characterized in that the subscriber identifier is a MSISDN number.

12. The method according to claim 6, characterized in that the piece of location information is a CellID identifier.

13. A method for obtaining the location information of a terminal device of a GPRS network, which method comprises the steps of:

creating a PDP context associated with the opening of a data-transmission connection;

sending a location-dependant service request to the service provider by means of the terminal device;

characterized in that the method further comprises the steps of:

a) finding out the IP address allocated to the PDP context and the subscriber identifier of the user of the GPRS terminal device;

b) saving the IP address allocated to the PDP context and the subscriber identifier of the user of the terminal device to the database;

c) sending an inquiry from the service provider that contains the IP address allocated to the PDP context;

d) finding out the subscriber identifier associated with the IP address from the database based on the inquiry;

e) sending from the location server to the home location register an ATI message consistent with the MAP protocol that contains the subscriber identifier of the user of the GPRS terminal device;

f) sending a PSI inquiry consistent with the MAP protocol from the home location register to the visitor location register;

g) sending a BSSAP+ MS Information Request message from the visitor location register to the SGSN node;

h) sending a BSSAP+ MS Information Response message of the GPRS terminal device from the SGSN node to the visitor location register;

i) sending from the visitor location register from the mobile switching center to the home location register a PSI response message consistent with the MAP protocol that contains the piece of location information;

j) sending from the home location register to the location server an ATI response message consistent with the MAP protocol that contains the piece of location information, and

k) transmitting the piece of location information from the location server to the service provider.

14. The method according to claim 13, characterized in that at step a) sending from the GGSN node, by means of the Radius protocol, a Radius message to the Radius server program that contains the IP address allocated to the PDP context and the subscriber identifier of the user of the GPRS terminal device.

15. The method according to claim 13, characterized in that at step a) monitoring the GTP tunnel in between the SGSN node and the GGSN node by means of the terminal device and picking up subscriber identifier/IP address pairs in the creation phase of the PDP context.

16. The method according to claim 13, characterized in that at step a) sending the subscriber identifier/IP address pair from the SGSN node to the location server.

17. The method according to claim 13, characterized in that the subscriber identifier associated with the PDP context and the IP address are deleted from the database, when the PDP context is released.

18. The method according to claim 13, characterized in that at step e) and j) substituting the ATI message with a SRI message consistent with the MAP protocol.

19. The method according to claim 13, characterized in that the subscriber identifier is a MSISDN number.

20. The method according to claim 13, characterized in that the piece of location information is a CellID identifier.

21. A method for obtaining the location information of a terminal device of a GPRS network, which method comprises the steps of:

creating a PDP context associated with the opening of a data-transmission connection;

sending a location-dependant service request to the service provider by means of the terminal device;

c h a r a c t e r i z e d in that the method further comprises the steps of:

a) finding out the IP address allocated to the PDP context and the subscriber identifier of the user of the GPRS terminal device;

b) saving the IP address allocated to the PDP context and the subscriber identifier of the user of the terminal device to the database;

c) sending an inquiry from the service provider that contains the IP address allocated to the PDP context;

d) finding out the subscriber identifier associated with the IP address from the database based on the inquiry;

e) finding out the IMSI identifier and the address of the serving mobile switching center from the home location register based on the subscriber identifier by means of the location server;

f) sending a short message from the location server to the GPRS terminal device via a circuit-switched connection;

g) sending an ATI message consistent with the MAP protocol from the location server to the home location register, the ATI message containing the subscriber identifier of the user of the GPRS terminal device;

h) sending a PSI inquiry consistent with the MAP protocol from the home location register to the visitor location register;

i) sending a PSI response message consistent with the MAP protocol from the visitor location register to the home location register, the PSI response message containing the piece of location information;

j) sending an ATI response message consistent with the MAP protocol from the home location register to

the location server, the ATI response message containing the piece of location information; and

k) transmitting the piece of location information from the location server to the service provider.

22. The method according to claim 21, characterized in that at step a) sending from the GGSN node, by means of the Radius protocol, a radius message to the Radius server program that contains the IP address allocated to the PDP context and the subscriber identifier of the user of the GPRS terminal device.

23. The method according to claim 21, characterized in that at step a) monitoring the GTP tunnel in between the SGSN node and the GGSN node by means of the location server and picking up subscriber identifier/IP address pairs from there in the creation phase of the PDP context.

24. The method according to claim 21, characterized in that at step a) sending the subscriber identifier/IP address pair from the SGSN node to the location server.

25. The method according to claim 21, characterized in that at step g) and j) substituting the ATI message with a SRI message consistent with the MAP protocol.

26. The method according to claim 21, characterized in that if at step f) the MMS bit is activated in the short message, then prior to step k):

sending a MAP Abort message from the location server to the mobile switching center.

27. The method according to claim 21, characterized in that the subscriber identifier associated with the PDP context and the IP address are deleted from the database, when the PDP context is released.

28. The method according to claim 21, characterized in that the subscriber identifier is a MSISDN number.

29. The method according to claim 21, characterized in that the piece of location information is a CellID identifier.

30. A location server for obtaining the location information of a terminal device of a telecommunication network, characterized in that the location server comprises:

message means (IP) for sending and receiving messages to the service provider/from the service provider (SP); and

a signaling interface (SS7) for sending and receiving signaling messages.

31. The location server according to claim 30, characterized in that the location server comprises data acquisition means (DM) for finding out the subscriber identifier/IP address pair associated with the user of the terminal device.

32. The location server according to claim 30, characterized in that the location server comprises a database for saving the subscriber identifier/IP address pair.

33. The location server according to claim 30, characterized in that the location server comprises message means (IP) for retrieving the subscriber identifier/IP address pair from the database (DB).

34. The location server according to claim 30, characterized in that the data acquisition means (DM) are used to refer to the Radius server program.

35. The location server according to claim 30, characterized in that the data acquisition means (DM) are used to refer to a data compiler

which is used to monitor the GTP tunnel (GTP) in between the SGSN node and the GGSN node

36. The location server according to claim 30, characterized in that the signaling interface (SS7) comprises means for sending and receiving signaling messages to the home location register/from the home location register (HLR) and to the SGSN node/from the SGSN node (SGSN).

37. The location server according to claim 30, characterized in that the signaling interface (SS7) comprises means for sending and receiving signaling messages to the home location register/from the home location register (HLR).

38. The location server according to claim 30, characterized in that the signaling interface (SS7) comprises means for sending and receiving signaling messages to the home location register/from the home location register (HLR) and to the mobile switching center/from the mobile switching center (MSC).

39. The location server according to claim 30, characterized in that the signaling interface (SS7) comprises means for sending and receiving signaling messages to the home location register/from the home location register (HLR) and to the visitor location register/from the visitor location register (VLR).

40. A system for obtaining the location information of a terminal device of a GPRS network, which system comprises:

a SGSN node (SGSN);

a GGSN node (GGSN), which is connected to the SGSN node (SGSN);

a GTP tunnel (GTP), which is located in between the SGSN node (SGSN) and the GGSN node (GGSN);

a service provider (SP), which communicates with the GGSN node (GGSN);

a GPRS terminal device (MS), which communicates with the SGSN node (SGSN);

a home location register (HLR);

characterized in that the system further comprises:

data acquisition means (DM) for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device;

a database (DB) for saving the subscriber identifier/IP address pairs obtained using the data acquisition means (DM);

a location server (LOC) which comprises:

message means (IP) for sending and receiving messages to the service provider/from the service provider (SP); and

a signaling interface (SS7) for sending and receiving signaling messages to the home location register/from the home location register (HLR) and to the SGSN node/from the SGSN node (SGSN).

41. The system according to claim 40, characterized in that the location server comprises a database (DB) for saving the subscriber identifier/IP address pairs.

42. The system according to claim 40, characterized in that the location server comprises message means (IP) for retrieving the subscriber identifier/IP address pairs from the database (DB).

43. The system according to claim 40, characterized in that the location server comprises data acquisition means (DM) for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device.

44. The system according to claim 40, characterized in that the data acquisition means (DM) are used to refer to the Radius server program.

45. The system according to claim 40, characterized in that the data acquisition means (DM) are used to refer to a data compiler which is used to monitor the GTP tunnel (GTP) in between the SGSN node (SGSN) and the GGSN node (GGSN).

46. The system according to claim 40, characterized in that the SGSN node (SGSN) comprises data transmission means (MM) for sending the subscriber identifier/IP address pair to the location server (LOC).

47. A system for obtaining the location information of a terminal device of a GPRS network, which system comprises:

a SGSN node (SGSN);

a GGSN node (GGSN), which is connected to the SGSN node (SGSN);

a GTP tunnel (GTP), which is located in between the SGSN node (SGSN) and the GGSN node (GGSN);

a service provider (SP), which communicates with the GGSN node (GGSN);

a GPRS terminal device (MS), which communicates with the SGSN node (SGSN);

a home location register (HLR);

a visitor location register (VLR), which communicates with the home location register (HLR) and with the SGSN node (SGSN);

a mobile switching center (MSC) which communicates with the visitor location register (VLR);

characterized in that the system further comprises:

data acquisition means (DM) for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device;

a database (DB) for saving the subscriber identifier/IP address pairs obtained using the data acquisition means (DM);

a location server (LOC) which comprises:

message means (IP) for sending and receiving messages to the service provider/from the service provider (SP); and

a signaling interface (SS7) for sending and receiving signaling messages to the home location register/from the home location register (HLR).

48. The system according to claim 47, characterized in that the location server comprises a database (DB) for saving the subscriber identifier/IP address pairs.

49. The system according to claim 47, characterized in that the location server comprises message means (IP) for retrieving the subscriber identifier/IP address pairs from the database (DB).

50. The system according to claim 47, characterized in that the location server comprises data acquisition means (DM) for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device.

51. The system according to claim 47, characterized in that the data acquisition means (DM) are used to refer to the Radius server program.

52. The system according to claim 47, characterized in that the data acquisition means (DM) are used to refer to a data compiler which is used to monitor the GTP tunnel (GTP) in between the SGSN node (SGSN) and the GGSN node (GGSN).

53. The system according to claim 47, characterized in that the SGSN node (SGSN) comprises data transmission means (MM) for sending the subscriber identifier/IP address pair to the location server (LOC).

54. The system according to claim 47, characterized in that the location server comprises a signaling interface (SS7) for sending and

receiving signaling messages to the visitor location register/from the visistor location register (VLR).

55. A system for obtaining the location information of a terminal device of a GPRS network, which system comprises:

a SGSN node (SGSN);

a GGSN node (GGSN), which is connected to the SGSN node (SGSN);

a GTP tunnel (GTP), which is located in between the SGSN node (SGSN) and the GGSN node (GGSN);

a service provider (SP), which communicates with the GGSN node (GGSN);

a GPRS terminal device (MS), which communicates with the SGSN node (SGSN);

a home location register (HLR);

a visitor location register (VLR), which communicates with the home location register (HLR)

a mobile switching center (MSC) which communicates with the visitor location register (VLR);

c h a r a c t e r i z e d in that the system further comprises:

data acquisition means (DM) for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device;

a database (DB) for saving the subscriber identifier/IP address pairs obtained using the data acquisition means (DM);

a location server (LOC) which comprises:

message means (IP) for sending and receiving messages to the service provider/from the service provider (SP); and

a signaling interface (SS7) for sending and receiving signaling messages to the home location register/from the home location register (HLR) and to the mobile switching center/from the mobile switching center (MSC).

56. The system according to claim 55, characterized in that the location server comprises a database (DB) for saving the subscriber identifier/IP address pairs.

57. The system according to claim 55, characterized in that the location server comprises message means (IP) for retrieving the subscriber identifier/IP address pairs from the database (DB).

58. The system according to claim 55, characterized in that the location server comprises data acquisition means (DM) for finding out the subscriber identifier/IP address pair associated with the user of the GPRS terminal device.

59. The system according to claim 55, characterized in that the data acquisition means (DM) are used to refer to the Radius server program.

60. The system according to claim 55, characterized in that the data acquisition means (DM) are used to refer to a data compiler which is used to monitor the GTP tunnel (GTP) in between the SGSN node (SGSN) and the GGSN node (GGSN).

61. The system according to claim 55, characterized in that the SGSN node (SGSN) comprises data transmission means (MM) for sending the subscriber identifier/IP address pair to the location server (LOC).

62. The system according to claim 55, characterized in that the location server comprises a signaling interface (SS7) for sending and receiving signaling messages to the visitor location register/from the visitor location register (VLR).

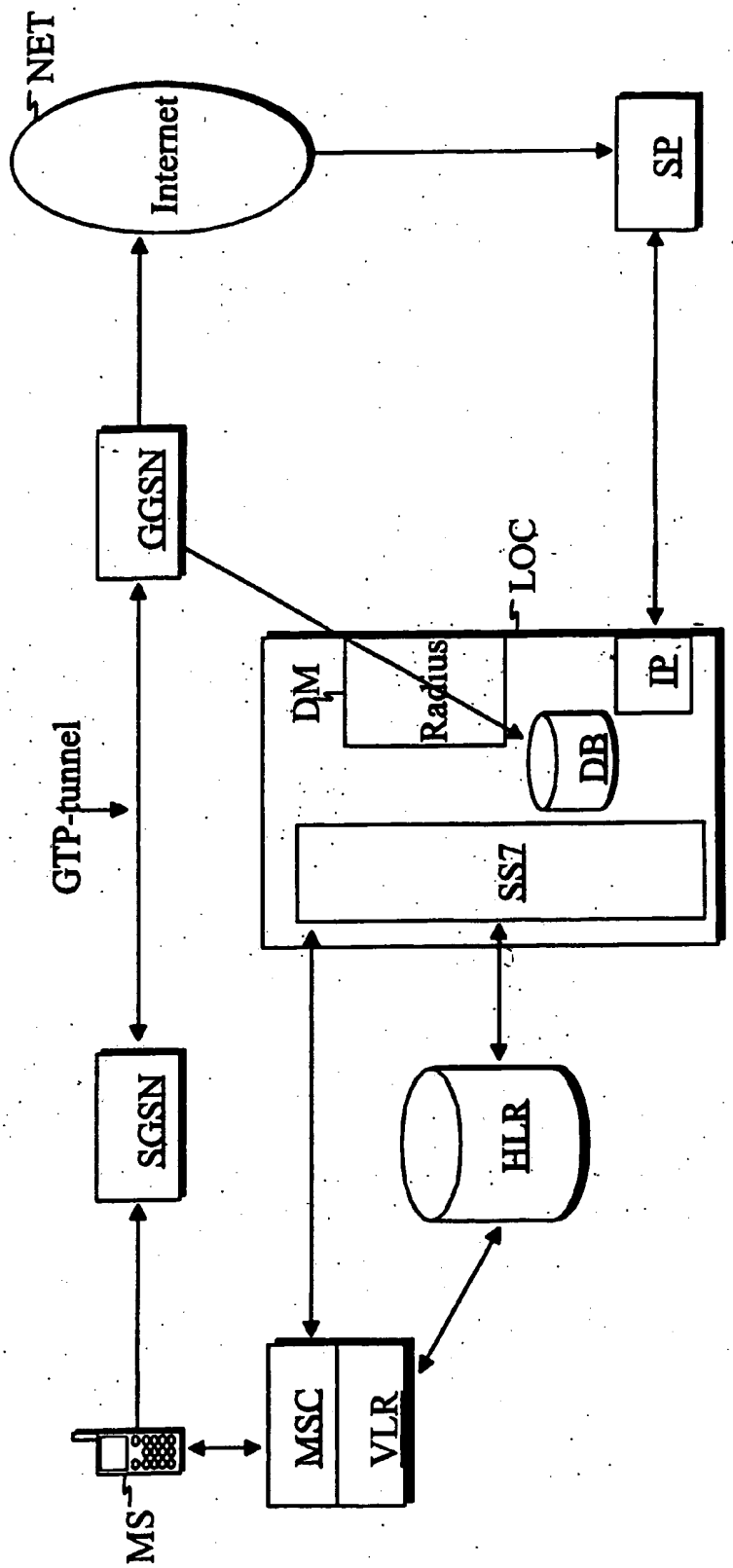

NET
Internet
SP
GGSN
LOC
DM
Radius
IP
DB
GTP-tunnel
SS7
SGSN
HLR
MSC
VLR
MS

Fig. 1

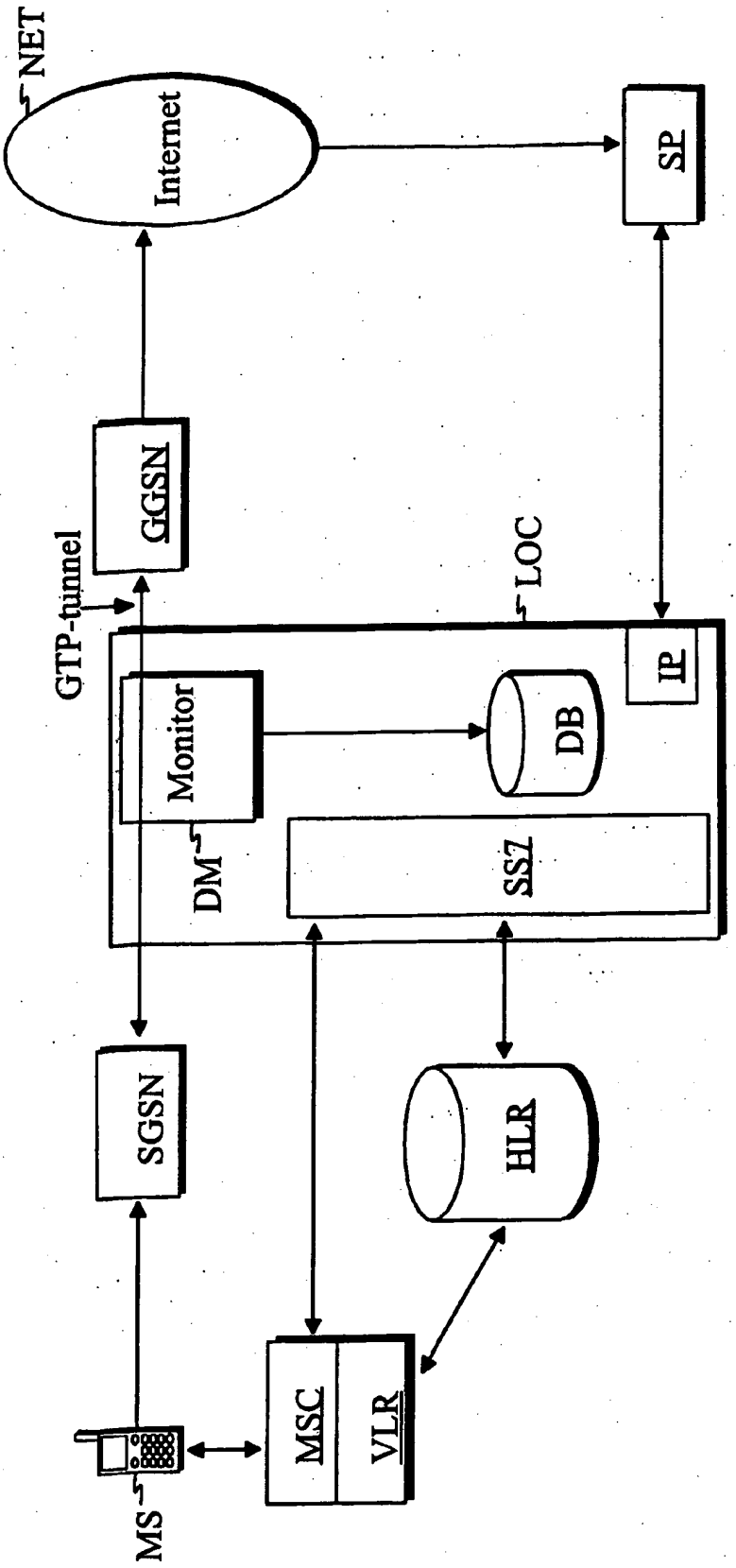

NET
Internet
SP
GGSN
GTP-tunnel
LOC
IP
Monitor
DB
DM
SSZ
SGSN
HLR
MSC
VLR
MS

Fig.2

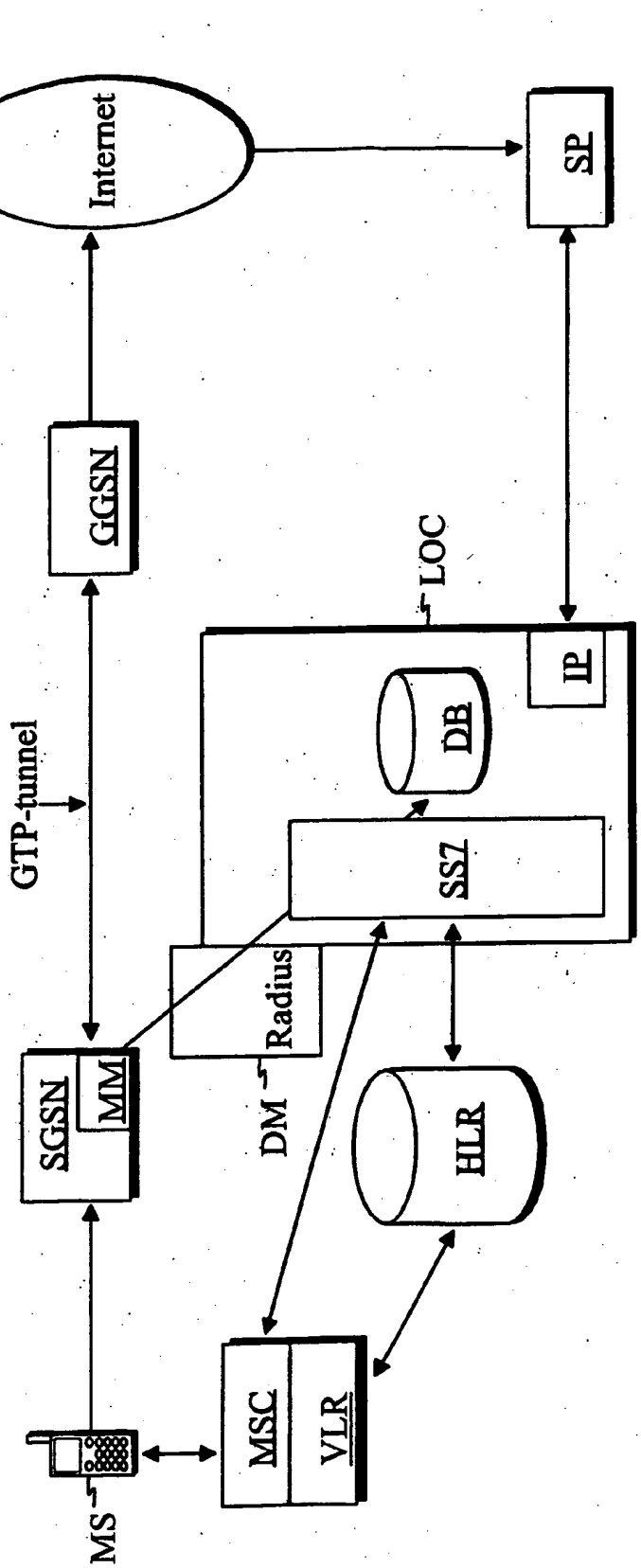
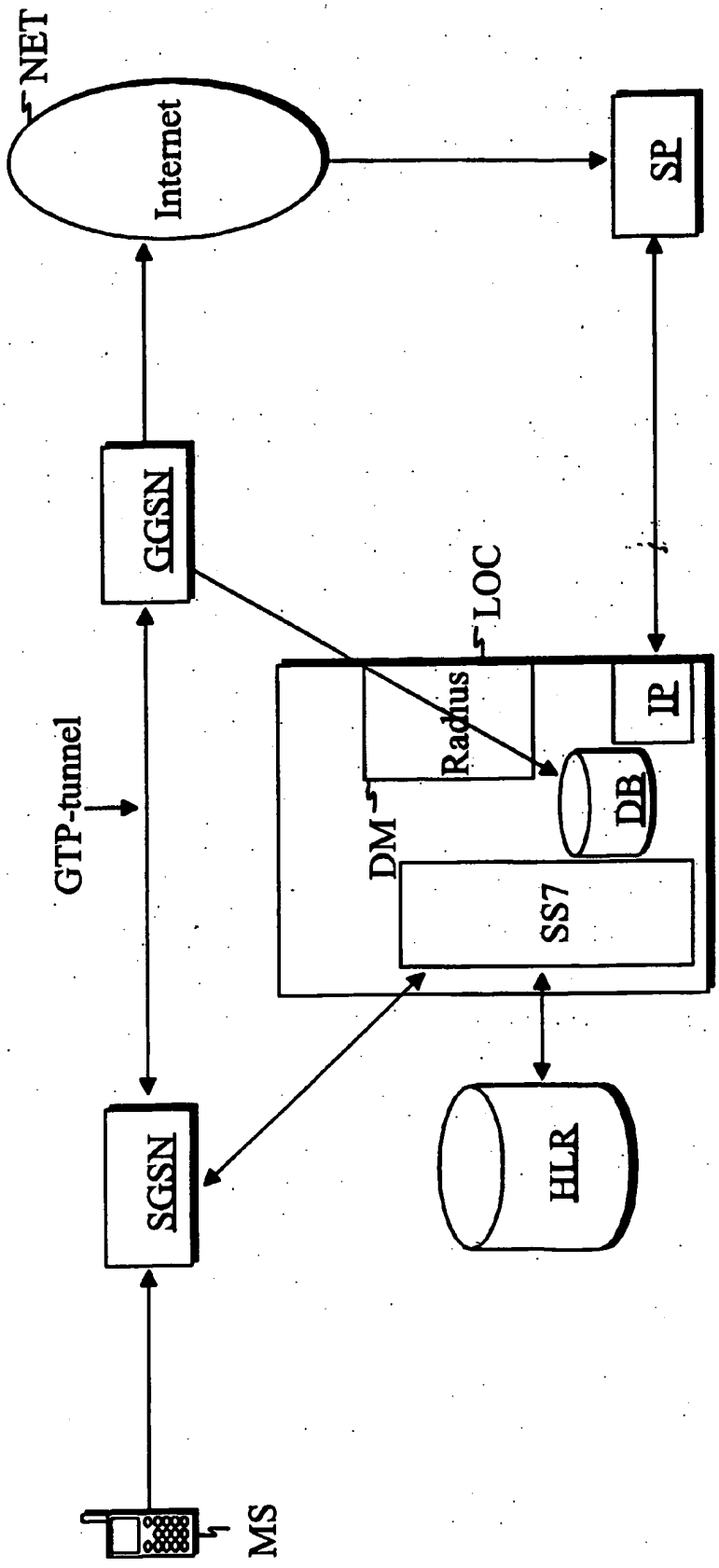

NET
Internet
SP
GGSN
LOC
IP
DB
GTP-tunnel
SS7
Radius
SGSN
MM
DM
HLR
MSC
VLR
MS

Fig. 3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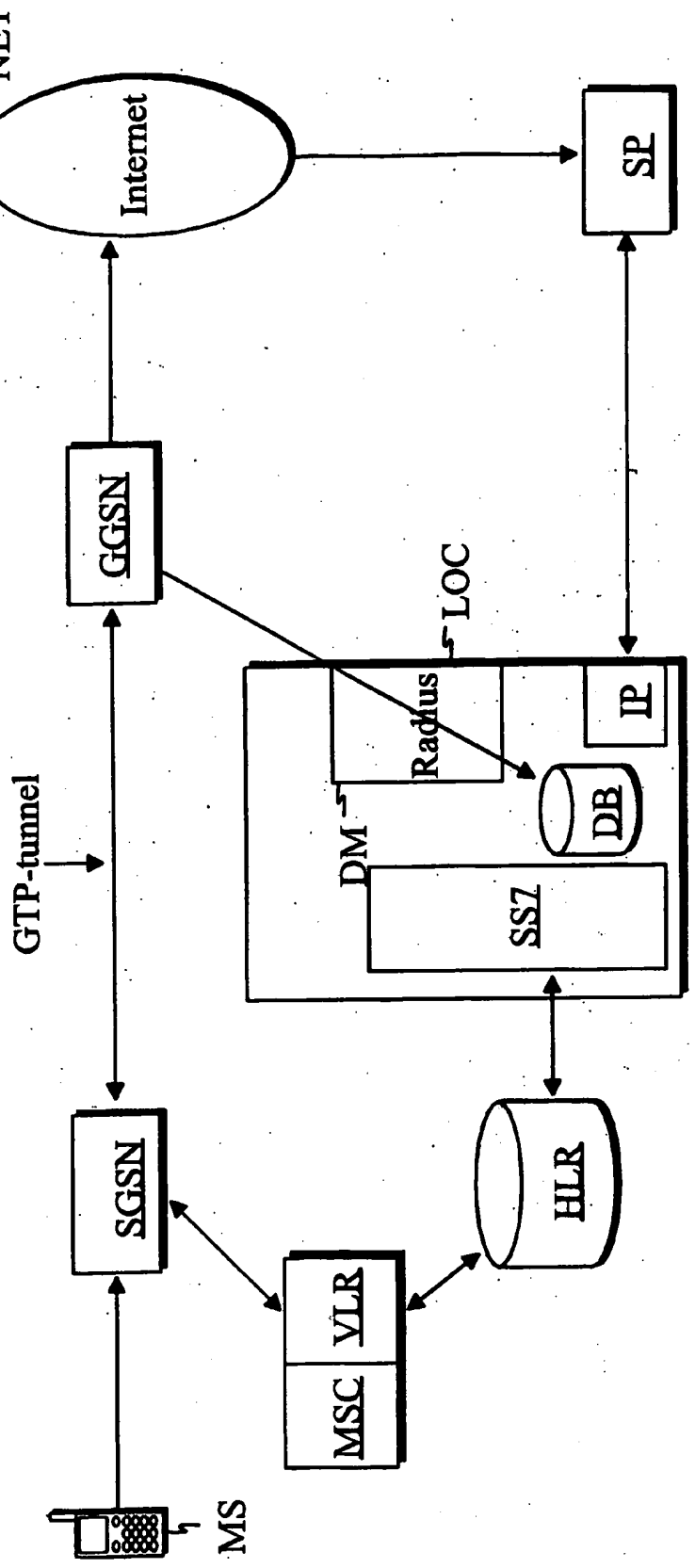
Internet
SP
GGSN
LOC
Radius
IP
DB
DM
SS7
GTP-tunnel
SGSN
HLR
MS

Fig. 4


NET
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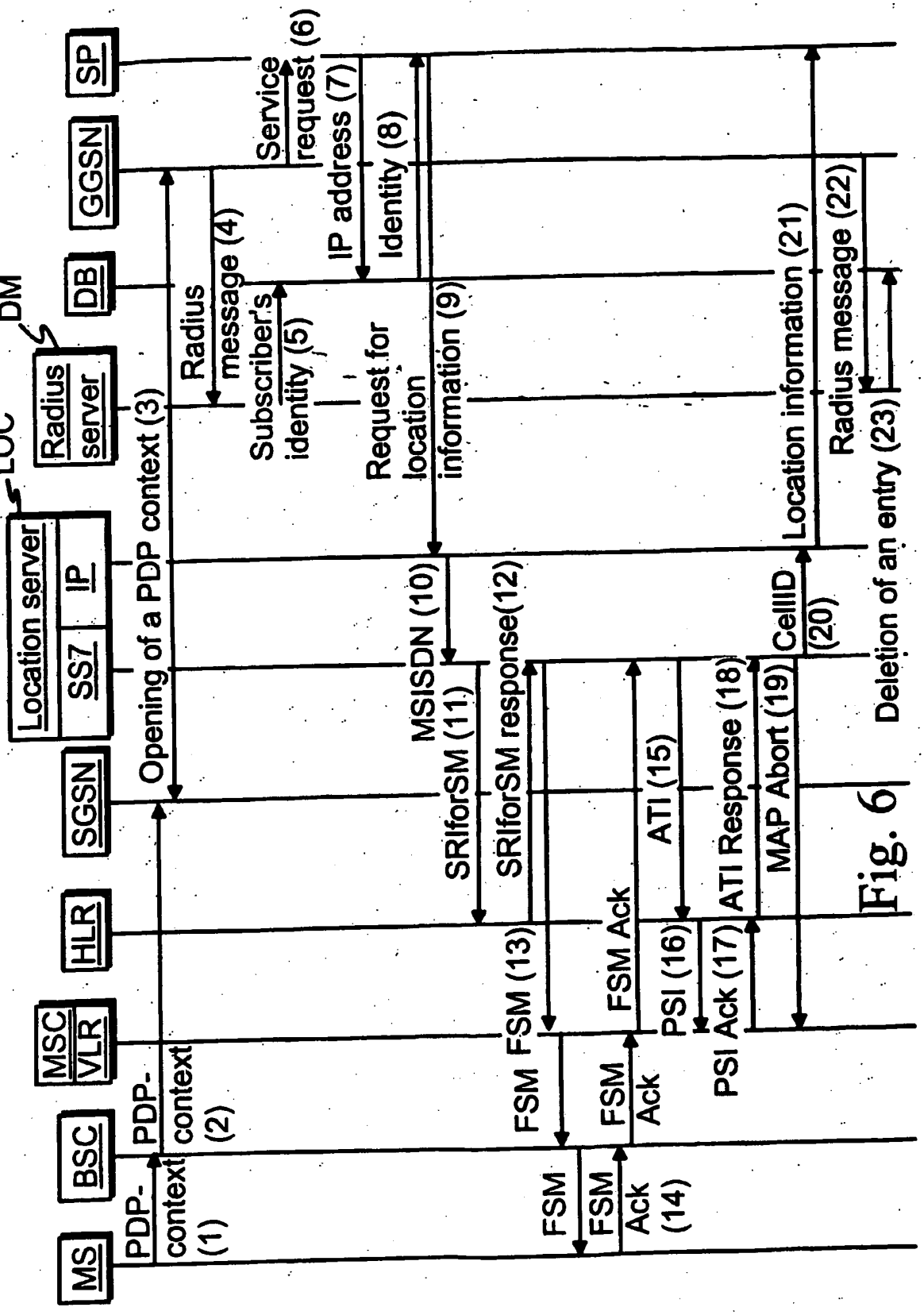
SP
GGSN
LOC
Radius
IP
DB
DM
SS7
GTP-tunnel
SGSN
HLR
VLR
MSC
MS

Fig. 5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MSC VLR
HLR
SGSN
Location server
SS7
IP
LOC
Radius server
DM
DB
GGSN
SP
PDP-context (1)
PDP-context (2)
Opening of a PDP context (3)
Radius message (4)
Subscriber's identity (5)
Service request (6)
IP address (7)
Identity (8)
Request for location information (9)
MSISDN (10)
SRIforSM (11)
SRIforSM response(12)
FSM (13)
FSM Ack (14)
PSI (16)
PSI Ack (17)
ATI (15)
ATI Response (18)
MAP Abort (19)
CellID (20)
Location information (21)
Radius message (22)
Deletion of an entry (23)

Fig. 6

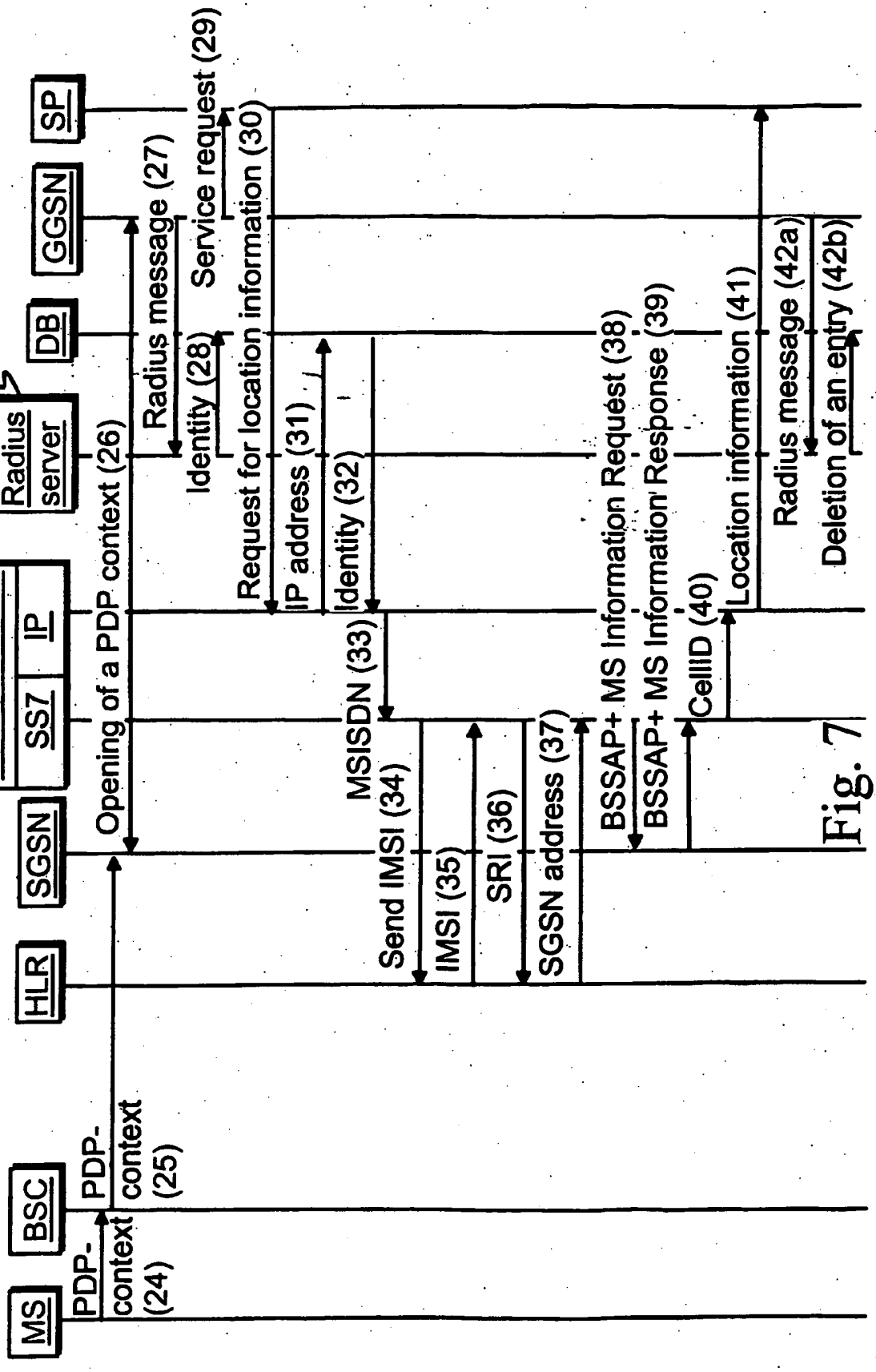
MS
BSC
HLR
SGSN
LOC
Location server
SS7
IP
Radius server
DM
DB
GGSN
SP
PDP-context (24)
PDP-context (25)
Opening of a PDP context (26)
Radius message (27)
Identity (28)
Service request (29)
Request for location information (30)
IP address (31)
Identity (32)
MSISDN (33)
Send IMSI (34)
IMSI (35)
SRI (36)
SGSN address (37)
BSSAP+ MS Information Request (38)
BSSAP+ MS Information Response (39)
CellID (40)
Location information (41)
Radius message (42a)
Deletion of an entry (42b)

Fig. 7

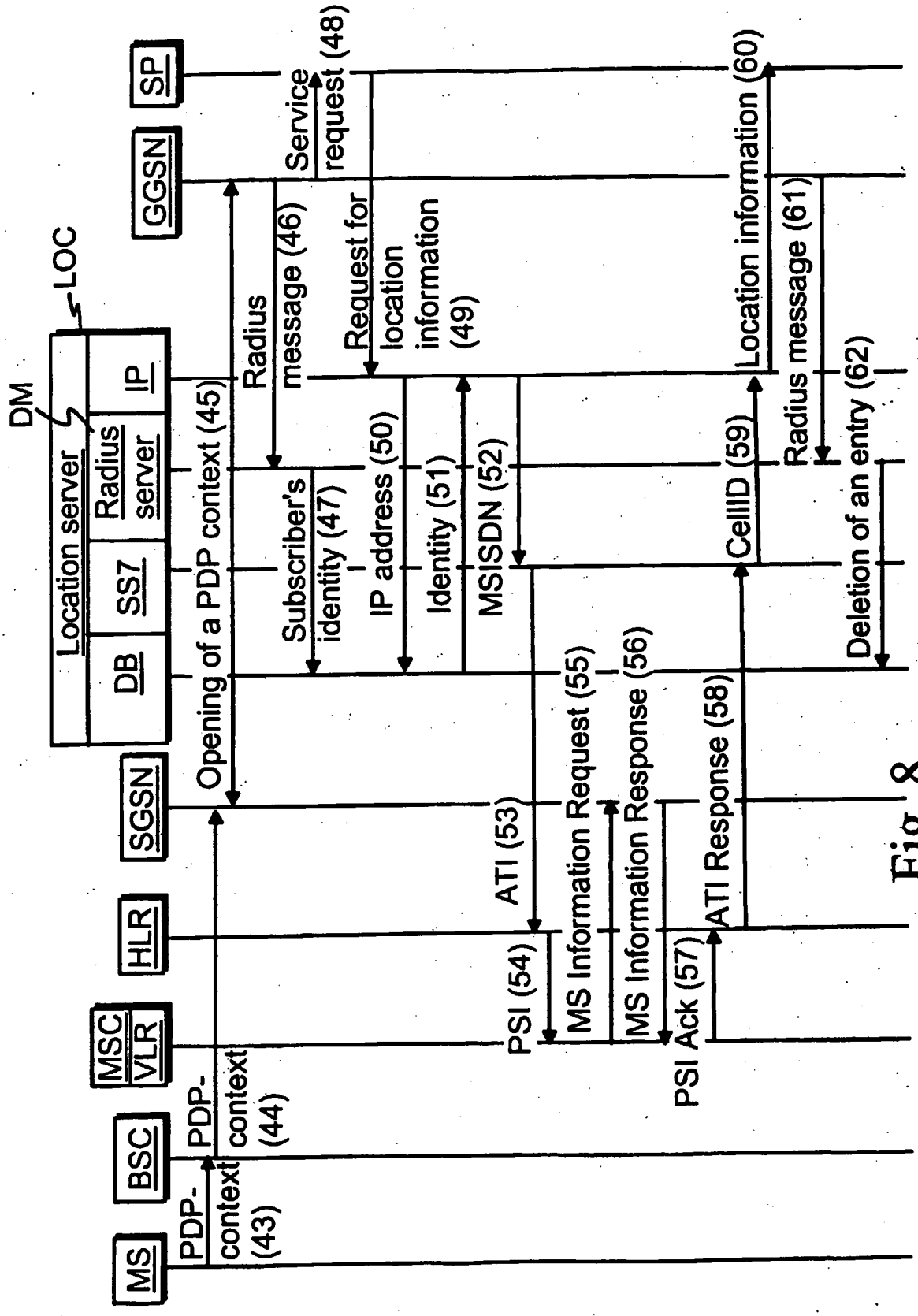
MS
BSC
MSC VLR
HLR
SGSN
DM
LOC
Location server
DB
SS7
Radius server
IP
GGSN
SP
PDP-context (43)
PDP-context (44)
Opening of a PDP context (45)
Radius message (46)
Service request (48)
Subscriber's identity (47)
Request for location information (49)
IP address (50)
Identity (51)
MSISDN (52)
ATI (53)
PSI (54)
MS Information Request (55)
MS Information Response (56)
PSI Ack (57)
ATI Response (58)
CellID (59)
Location information (60)
Radius message (61)
Deletion of an entry (62)

Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 01/01105

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/38, H04Q 7/22, H04L 29/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	WO 0079761 A1 (NOKIA NETWORKS OY), 28 December 2000 (28.12.00), page 5, line 15 - page 6, line 27	1-6,8-13, 15-21,23-33, 35-43,45-50, 52-58,60-62
	--	
X	WO 0044148 A1 (3COM CORPORATION), 27 July 2000 (27.07.00)	1-62
Y	abstract, page 3 line 8 - page 5 line 1	7,14,22,34, 44,51,59
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 March 2002	21-03-2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Stefan Hansson/JAn Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 01/01105

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 0076171 A1 (NOKIA NETWORKS OY), 14 December 2000 (14.12.00)	1-6,8-13, 15-21,23-33, 35-43,45-50, 52-58,60-62
Y	page 5, line 6 - line 12; page 6, line 19 - line 34, page 8 line 28 - page 9 line 13, page 24 line 21-29	7,14,22,34, 44,51,59
	--	
A	US 5901352 A (ST-PIERRE ET AL), 4 May 1999 (04.05.99), abstract	1-62
	--	

Form PCT/ISA/210 (continuation of second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/01/02

International application No.
PCT/FI 01/01105

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0079761 A1	28/12/00	AU 5096300 A	09/01/01
WO 0044148 A1	27/07/00	AU 3104900 A	07/08/00
WO 0076171 A1	14/12/00	AU 4603000 A	28/12/00
		GB 0005378 D	00/00/00
		GB 9913453 D	00/00/00
US 5901352 A	04/05/99	AU 6127098 A	09/09/98
		BR 9807426 A	21/03/00
		WO 9837724 A	27/08/98